

WHAT IS CLAIMED IS:

1. A vehicle collision state detecting device of a vehicle, comprising:  
a front vehicle structural section having a predetermined collision collapsing  
characteristic;

5 a tension member with a prescribed initial tensile force extending in a width-wise  
direction of the front vehicle structural section;

left and right tensile force sensors arranged on the front vehicle structural section  
to measure left and right tensile forces of the tension member; and

a collision state identifying section configured to identify a collision state of the  
10 vehicle based on a comparison between the left and right tensile forces of the tension  
member measured by the left and right tensile force sensors.

2. The vehicle collision state detecting device recited in claim 1, wherein  
the front vehicle structural section includes

15 a left side structural member configured with a rigidity balance to  
collapse inward when subjected to a left side load oriented in a  
widthwise direction of the vehicle;

a right side structural member configured with a rigidity balance to  
collapse inward when subjected to a right side load oriented in  
20 the widthwise direction of the vehicle;

a left side deformable member arranged on a forward tip end of the  
left side structural member;

a right side deformable member arranged on a forward tip end of  
the right side structural member; and

25 a bumper reinforcement arranged crosswise in the widthwise  
direction of the vehicle with end portions fixedly coupled at  
front end parts of the left and right easily deformable members.

3. The vehicle collision state detecting device recited in claim 2, wherein  
30 the tension member includes a wire extending along the bumper reinforcement  
between the left and right structural members.

4. The vehicle collision state detecting device recited in claim 1, wherein the tension member includes a wire extending in the widthwise direction of the vehicle with end portions fixedly coupled at lateral parts of the front vehicle structural section.

5. The vehicle collision state detecting device recited in claim 1, wherein the collision state identifying section is configured to identify the collision state as a front collision when the left and right tensile forces of the tension member measured by the left and right tensile force sensors both decrease below the initial tensile force that existed before a collision and the left and right tensile forces of the tension member are approximately equal to each other after the collision.

6. The vehicle collision state detecting device recited in claim 1, wherein the collision state identifying section is configured to identify the collision state as a simple offset collision when one of the left and right tensile force sensors detects a decrease in one of the left and right tensile forces of the tension member below the initial tensile force that existed before the collision on the side where a collision occurred, and the other of the left and right tensile force sensors detects an increase in one of the left and right tensile forces of the tension member above the initial tensile force that existed before the collision on the side where the collision did not occur.

7. The vehicle collision state detecting device recited in claim 1, wherein the collision state identifying section is configured to identify the collision state as a pole collision when the left and right tensile forces of the tension member measured by the left and right tensile force sensors both increase above the initial tensile force that existed before a collision.

8. The vehicle collision state detecting device recited in claim 1, wherein the collision state identifying section is configured to identify the collision state as an oblique offset collision when the left and right tensile forces of the tension member

measured by the left and right tensile force sensors both decrease below the initial tensile force that existed before a collision and the left and right tensile forces of the tension member are not approximately equal to each other.

5           9.       The vehicle collision state detecting device recited in claim 1, wherein the collision state identifying section is configured to determine a threshold value for activating at least one passenger restraining device in accordance with the collision state identified based on the comparison between the left and right tensile forces of the tension member measured by the left and right tensile force sensors.

10           10.       The vehicle collision state detecting device recited in claim 9, further comprising  
a deceleration sensor configured to measure a deceleration of the vehicle; and  
the collision state identifying section being further configured to calculate a  
15 velocity waveform with respect to time based on the deceleration measured by the deceleration sensor and activate the passenger restraining device based on the calculated velocity waveform and the threshold value determined by the collision state identifying section.

20           11.       The vehicle collision state detecting device recited in claim 1, wherein the collision state identifying section determines an activation timing with which a passenger restraining device will be activated and a passenger restraining force based on an amount of decrease with respect to time in the left and right tensile forces of the tension member measured by the left and right tensile force sensors.

25           12.       The vehicle collision state detecting device recited in claim 1, wherein the front vehicle structural section is configured to deform such that left and right lateral side portions collapse inward relative to the vehicle at side locations, respectively, that are in front of a respective one of the left and right tensile force sensors when  
30 subjected to a load oriented in the widthwise direction of the vehicle.

13. The vehicle collision state detecting device recited in claim 1, further comprising

5 a lock mechanism configured to divide and fix the tension member in such a manner that independent tensile forces are generated in left and right section of the tension member when a collision occurs.

14. The vehicle collision state detecting device recited in claim 13, wherein the lock mechanism includes a plurality of protruding parts around a periphery of a plurality of stopper parts connected to the tension member and is configured in such a  
10 manner that when a load is imparted to the protruding parts, the structure surrounding the protruding parts deforms and causes the protruding parts and stopper parts to interfere with each other to restrict movement of the tension member.

15. The vehicle collision state detecting device recited in claim 14, wherein  
15 the protruding parts of the lock mechanism has a saw-tooth-shaped mountain structure and the stopper parts of the lock mechanism has a saw-tooth-shaped valley structure that mates with the saw-tooth-shaped mountain structure with the tension member being arranged between the saw-tooth mountain structure and the saw-tooth valley structure.

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16. A vehicle collision state detecting device comprising:  
front vehicle structural supporting means for providing structural support to a front portion of a vehicle;

25 tensioned means for providing a prescribed initial tensile force extending in a width-wise direction of the front vehicle structural section;

tensile force measuring means for measuring left and right tensile forces of the tensioned means; and

30 collision state identifying means for identifying a collision state of the vehicle based on a comparison between the left and right tensile forces of the tensioned means measured by the tensile force measuring means.

17. A vehicle collision state detecting device comprising:

a collision sensing device configured and arranged to be installed on a front portion of a vehicle to produce a collision state signal indicative of a detected collision state of the vehicle;

5 a collision state identifying section operatively coupled to the collision sensing device and configured to identify the detected collision state of the vehicle;

at least one passenger restraining device configured and arranged to be selectively activated; and

10 a control unit configured and arranged to selectively activate the at least one passenger restraining device differently depending on the detected collision state identified by the collision state identifying section.

18. The vehicle collision state detecting device recited in claim 17, wherein the collision sensing device includes

15 a front vehicle structural section having a predetermined collision collapsing characteristic,

a tension member with a prescribed initial tensile force extending in a width-wise direction of the front vehicle structural section, and left and right tensile force sensors arranged on the front vehicle

20 structural section to measure left and right tensile forces of the tension member; and

the collision state identifying section is configured to identify the collision state of the vehicle based on a comparison between the left and right tensile forces of the tension member measured by the left and right tensile force sensors.

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19. The vehicle collision state detecting device recited in claim 17, wherein

the control unit is configured and arranged to set an activation timing of the at least one passenger restraining device differently depending on the detected collision state identified by the collision state identifying section.

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20. The vehicle collision state detecting device recited in claim 17, wherein the at least one passenger restraining device includes at least one air bag, and the control unit is configured and arranged to inflate the at least one passenger differently depending on the detected collision state identified by the collision state  
5 identifying section.

21. The vehicle collision state detecting device recited in claim 20, wherein the at least one air bag includes a first air bag and a second air bag, and the control unit is configured and arranged to set an activation timing of the first  
10 and second air bag differently depending on the detected collision state identified by the collision state identifying section.

22. A method comprising:  
sensing a collision state of a front portion of a vehicle;  
15 producing a detected collision state signal in response to the collision state that was sensed;  
identifying the collision state of the vehicle as at least one of two different preset based on a detected collision state by the collision sensing device; and  
selectively activating at least one passenger restraining device differently  
20 depending on the collision state identified.